

EVALUATION OF ARCTIC GRAYLING ENHANCEMENT IN THE TANANA DRAINAGE DURING 1986

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ABSTRACT

Since 1983, hatchery and pond reared Arctic grayling (*Thymallus arcticus* Pallas) fingerlings have been stocked in the Delta Clearwater River in June, August, September and October. Release times and rearing methods were compared for relative survival and contribution to the sport fishery. Results have been somewhat inconclusive; although Arctic grayling stocked in late September or early October returned to the river in greater proportions than Arctic grayling stocked earlier in the summer.

Two roadside ponds near Fairbanks were stocked with Arctic grayling fingerlings in September 1985. In June 1986, the estimated survival rate of stocked Arctic grayling in one pond was 0.33. The mean growth in length for Arctic grayling stocked in these two ponds over the 10 month period was 40 and 43 millimeters, respectively.

KEY WORDS: Arctic grayling, *Thymallus arcticus*, enhancement techniques, stocking time, rearing methods, Delta Clearwater River.

INTRODUCTION

The Arctic grayling (*Thymallus arcticus*, Pallas) enhancement evaluation project for interior Alaska consisted of two separate studies during 1986. The first study was initiated in 1975 to evaluate the survival, growth, and contribution to the sport fishery of pond reared Arctic grayling (hereafter referred to as grayling) that were stocked in the Delta Clearwater River. Hatchery reared grayling have been stocked in the Delta Clearwater River since 1983 and this enhancement effort is being evaluated. The second study was started in 1985 to evaluate the survival and growth of grayling stocked as fingerlings in roadside ponds near Fairbanks, Alaska.

River Study

The Delta Clearwater River is a clear, 27 km long, spring-fed system located about 22 km north of Delta Junction, Alaska (Figure 1). The fishery has accounted for a mean annual harvest (1977-1984) of 6,103 grayling, with an average annual effort of 5,830 man-days (Ridder 1983; Mills 1985). The Delta Clearwater River grayling population is composed of mixed stocks that use the Delta Clearwater River for summer rearing. These fish overwinter and spawn in at least three other rivers (Pearse 1974; Tack 1980; Ridder 1983).

Enhancement of the Delta Clearwater River grayling stock began in 1973 because of low stock abundance and changes in age composition (Pearse 1974). Hatchery reared sac-fry were stocked directly into the river. Pearse (1975) was unable to locate these fish during later sampling. To increase survival, a rearing program was initiated in 1975. Hatchery reared sac-fry were stocked in rearing ponds in the spring, removed in the fall and stocked as fingerlings in the Delta Clearwater River (pond fish).

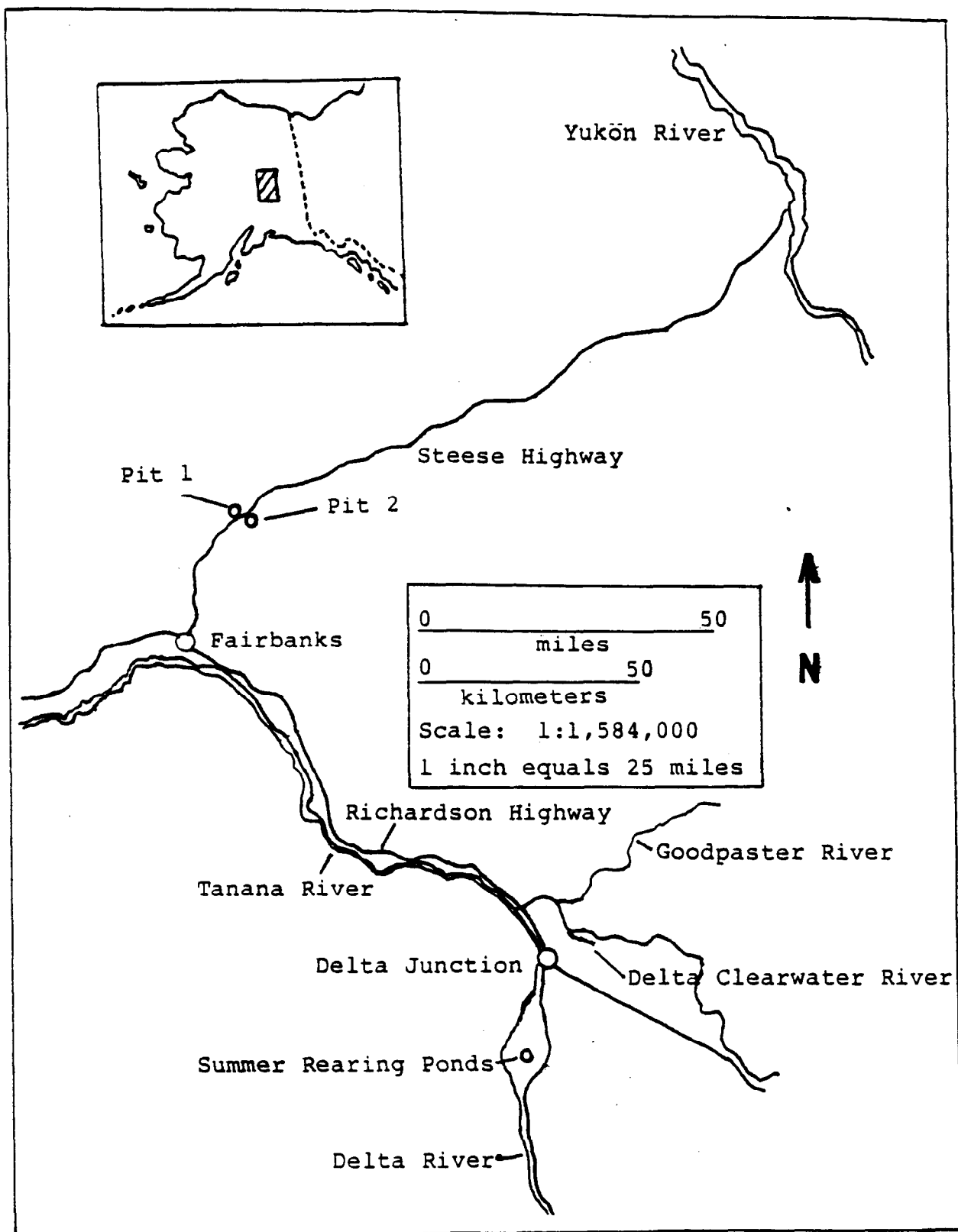


Figure 1. Fairbanks and Delta Junction study areas.

Since 1983, hatchery reared fingerlings have also been stocked (hatchery fish).

The assessment of these enhancement techniques has been researched since 1975. The contribution of pond reared fish to the Delta Clearwater River population prior to 1983 was evaluated using scale circuli counts because pond reared fish had higher growth rates and circuli counts than wild fish. After stocking of hatchery reared fingerlings began in 1983, grayling were marked with fin clips or Floy tags to distinguish rearing methods and stocking times. Year class contributions of both pond and hatchery reared grayling have ranged from 0 to 76%. Collectively, pond reared fish have comprised from 6 to 31% of the total population from 1979 to 1985. The brood sources, stocking times, and marking techniques have varied over the years and differences in the effectiveness of techniques need evaluation.

The goal of this research to determine the most effective method of enhancing grayling in the Delta Clearwater River. The objectives of the 1986 river study were to:

1. Estimate the proportional contribution of enhanced grayling by age class to the Delta Clearwater River stock;
2. Test the null hypothesis that rearing methods (pond versus hatchery) did not effect survival of grayling stocked in the Delta Clearwater River; and,
3. Test the null hypothesis that release time (June, August, September) did not effect survival of grayling stocked in the Delta Clearwater River.

Pond Study

Stocking of grayling sac-fry in Alaskan lakes and ponds began in 1961 (Van Wyhe 1963). These stocked fish exhibited high growth rates and survived low winter dissolved oxygen concentrations. The stocking of grayling sac-fry by the Alaska Department of Fish and Game (ADF&G) has created many new recreational fisheries in lakes and ponds that could not support other game fish. Stocking sac-fry in lakes and ponds has become a major enhancement technique in Alaska and about 3 million sac-fry have been stocked annually.

Unfortunately, this enhancement method has a serious disadvantage. Grayling sac-fry stocked in lakes and ponds have very high mortality rates (66-99%), especially when other species are present (Jennings 1983). Since mortality is often high, large numbers of eggs must be taken from wild stocks every year to meet enhancement needs. Large scale egg takes are expensive and have not always been successful (Jennings 1983). With the recent development of hatchery rearing techniques, survival of grayling to fingerling size in Clear Hatchery has increased to as high as 80% (Dave Parks, ADF&G personal communication). The specific objective of the pond enhancement study in 1986 was to estimate the survival and growth

of age 1 grayling that were stocked as age 0 fingerlings in two road side ponds near Fairbanks, Alaska.

MATERIALS AND METHODS

River Study

The proportional contribution of stocked fish in the Delta Clearwater River grayling stock was estimated from samples collected from: (1) a fyke net set in a clearwater slough near the mouth of the river from mid-April through the first of May; (2) creel surveys conducted from mid-May through Labor Day; and (3) population sampling efforts conducted in July using an electrofishing boat. Age, sex, length (fork length; hereafter referred to as FL), tag and fin clip data were collected from sampled grayling.

Since 1983, all hatchery and pond reared grayling have been marked with tags or fin clips prior to stocking except in 1984 and 1985, when about 50% of the hatchery reared fish were marked (Table 1). To estimate the number of hatchery fish captured, the number of marked fish captured from each year class was divided by the respective proportion of fish marked.

The hatchery reared fingerlings were stocked in the Delta Clearwater River in August and September at age 0. Age 0 pond reared fingerlings were stocked in the river in August, September, and October. Age 1 pond reared fingerlings were stocked in the river in June, September, and October (Table 1). Because of the short time span, grayling that were stocked in late September and early October are hereafter referred to as September fish.

Chi-square contingency tables were used to evaluate differences in the numbers of hatchery reared and pond reared fish that were captured and to evaluate the differences in the numbers of fish that were captured but stocked in different months (June versus August versus September).

Pond Study

Two ponds along the Steese Highway (Figure 1) at Milepost 31.2 (Pit 1) and Milepost 34.6 (Pit 2) were stocked with 1,600 and 1,663 grayling fingerlings, respectively, on 25 September 1985. The fish were hatched and reared at Clear Hatchery. The fish were marked with an adipose fin clip at the hatchery prior to release. The ponds are 0.8 and 1.6 ha, respectively and both ponds are small gravel pits that have maximum depths of about 3 m. Both have been intermittently stocked with unmarked grayling sac-fry since 1975.

Both ponds were sampled from 23 June to 27 June 1986 to estimate population abundance, survival, and growth of the stocked fingerlings. Fish were captured in a fyke net set in each pond. Captured grayling were marked by clipping the upper or lower lobe of the caudal fin, measured to the nearest 1 mm (FL), and released.

Table 1. Summary of grayling stocked in the Delta Clearwater River, 1983-1986.

Brood Source	Rearing Location	Date Stocked	Number Stocked	Mean Weight (g)	Mean Length (mm)	Marks:	
						Type ³	Number
Jack	Hatchery	8/31/83	2,503	2.3	60	RP	All
Jack	Hatchery	9/30/83	2,983	5.5	86	RV	All
Moose	Ponds	8/26/83	2,189	11.4	108	Ad&LV	All
Moose	Ponds	9/23/83	3,292	25.3	120	Ad	All
Sub-total			10,967				
Moose ¹	Ponds	6/8/84	1,009	—	170	Tag	All
Moose ¹	Ponds	9/21/84	122	198.0	232	Tag	All
Jack	Hatchery	9/26/84	17,380	2.2	62	LV	8,038
Sub-total			18,511				
Moose ¹	Ponds	6/14/85	551	—	172	Tag	All
Moose ¹	Ponds	10/3/85	638	—	211	Tag	All
GP ²	Ponds	10/1/85	12,744	11.1	103	LP	All
GP	Hatchery	9/20/85	20,950	4.7	76	Ad	10,468
Sub-total			34,883				
GP ²	Ponds	8/29/86	4,273	7.3	88	Ad/Lv	All
GP	Hatchery	8/27/86	5,748	3.7	76	Lv	All
GP	Ponds	9/26/86	6,940	11.6	100	Ad/Rp	All
GP	Ponds	10/3/86	2,928	6.8	88	Ad/Rp	All
GP	Hatchery	9/24/86	6,016	7.5	90	Rp	All
Sub-total			25,905				
Totals			Age 1	2,320			
			Age 0	87,946			
				90,266			

1 Stocked at age 1 (second summer).

2 Goodpaster River.

3 RP = Right ventral fin clip; LP = Left ventral fin clip; Ad = Adipose fin clip; Tag = Floy internal anchor tag.

The estimated population (and 95% confidence interval) of stocked fish was calculated using Schnabel's binomial model (Seber 1982). Survival was calculated as the estimated number of fish that survived to age 1 divided by the number stocked. Growth was estimated as the difference between the mean length of the fish when stocked and the mean length of the fish when captured.

RESULTS AND DISCUSSION

River Study

Of the 3,204 age 1, 2, and 3 grayling captured with the fyke net in 1986, 1,977 (61.7%) had been stocked (Table 2). Of the 41 grayling (age 1, 2, and 3) sampled while electrofishing, 6 (14.6%) had been stocked (Table 3). Creel survey clerks examined 123 grayling of which 4 (3.3%) had been stocked (Table 3).

Two pond reared grayling that were stocked in the Delta Clearwater River in 1985 were captured during population sampling in the Goodpaster River on 11 and 12 August 1986 (Clark and Ridder 1987). Anglers reported catching one tagged grayling in Clearwater Lake Outlet on 8 August 1986 and another grayling in Clear Creek on 6 July 1986. Both grayling had been stocked in the Delta Clearwater River in June 1985.

Time of Stocking:

For the 1983, 1984, and 1985 releases, the relative survival (number captured divided by number stocked) was higher for hatchery reared and pond reared grayling that were stocked in September (Table 4).

Grayling stocked in the Delta Clearwater River during September were larger than grayling stocked during June and August for the same year class (Table 1). Improved survival of grayling stocked in September may be due to size at stocking rather than time of stocking or may be due to both variables.

Hatchery Rearing Versus Pond Rearing:

For the August 1983 release, there was a significant difference ($\alpha=.05$; $P<0.01$) between the relative survival of hatchery reared grayling versus pond reared grayling (Table 5). The relative survival was higher for hatchery reared grayling. However, there was little difference between hatchery and pond reared grayling released during September 1983 ($\alpha=.05$; $0.05<P<0.10$). For the September 1985 release, there was a significant difference ($\alpha=.05$; $P<0.001$) between the relative survival of hatchery reared grayling versus pond reared grayling (Table 5) with the relative survival of pond reared grayling being higher.

These results are inconclusive because of mixed conclusions for different years (Table 5). It is not known if the brood source used (Table 1) in

Table 2. Summary of grayling captured during fyke net sampling in the Delta Clearwater River, 1984 to 1986.

Brood Source	Rearing Location	Release Date	Number captured in:		
			1984	1985	1986
Jack	Hatchery	8/31/83	49	1	4
Jack	Hatchery	9/30/83	79	5	3
Moose	Ponds	8/26/83	21	1	2
Moose	Ponds	9/23/83	87	6	11
Sub-total			236	13	20
Moose ¹	Ponds	6/8/84	NA	0	2
Moose ¹	Ponds	9/21/84	NA	2	0
Jack	Hatchery	9/26/84	NA	60	52
Sub-total			NA	62	54
Moose ¹	Ponds	6/14/85	NA	NA	7
Moose ¹	Ponds	10/3/85	NA	NA	23
Goodpaster	Ponds	10/1/85	NA	NA	1587
Goodpaster	Hatchery	9/20/85	NA	NA	286
Sub-total			NA	NA	1903
Total Catch of Enhancement Grayling			236	75	1,977
Total Catch of Wild and Stocked Grayling			1,566	248	3,204

1 Stocked at age 1 (second summer).

Table 3. Summary of age 1, 2, and 3 grayling captured in the Delta Clearwater River, 1986.

		Length (mm) of grayling sampled from:									
Age	Origin	Fyke Net:			Creel:			Electrofishing:			Total Sample Size
		n ¹	mean	SE ²	n	mean	SE	n	mean	SE	
1	Wild	526	85	0	0			1	124	--	527
	Hatchery	286	90	1	0			0			286
	Ponds	1587	117	0	0			0			1587
	Totals	2399			0			1			2400
2	Wild	476	135	1	1	217	--	0			477
	Hatchery	52	113	2	0			0			52
	June Yrlgs ³	7	199	3	1	299	--	1	215	--	9
	Sept Yrlgs	23	220	2	3	253	21	1	206	--	27
	Totals	558			5			2			565
3	Wild	188	188	1	8	239	8	8	232	8	204
	Aug Hatch ⁴	4	148	19	0			0			4
	Sept Hatch	3	172	22	0			0			3
	Aug Ponds	2	238	11	0			1	276	--	3
	Sept Ponds	11	234	4	0			2	243	19	13
	June Yrlgs	2	217	7	0			1	233	--	3
	Sept Yrlgs	0			0			0			0
	Totals	210			8			12			230

1 n = the sample size.

2 SE = the standard error.

3 Yrlgs = yearlings.

4 Hatch = hatchery.

Table 4. Chi-square comparisons of grayling captured in June, August, and September, 1984-1986.

Stocking Group	Cohort	Number Stocked	Number Captured ¹ :		Chi Squared Statistic	P-value
			Observed	Expected		
Aug Hatchery	1983	2503	54	64	2.98	.05 < p < .10
Sept Hatchery	1983	2983	87	77		
Aug Ponds	1983	2189	24	54	28.66	p < .001
Sept Ponds	1983	3292	114	84		
June Yearling ²	1983	1009	25	30	8.14	p < .005
Sept Yearling	1983	122	9	4		
June Yearling	1984	551	14	30	15.95	p < .001
Sept Yearling	1984	638	52	36		

1 For the 1983 fingerling release, data are from fyke net sampling, 1984-1986; for the 1983 yearling release, data are from fyke net sampling, electrofishing, and creel surveys in 1985 and 1986; for the 1984 yearling release, data are from fyke net sampling, electrofishing, and creel surveys in 1986.

2 Yearlings were reared in ponds and stocked during their second summer.

Table 5. Chi-square comparisons of hatchery and pond reared grayling captured in the Delta Clearwater River, 1984-1986.

Stocking Group	Cohort	Number Stocked	Number Captured:		Chi Squared Statistic	P-value
			Observed	Expected		
Aug. Hatchery	1983	2,503	54	42	7.78	p <.01
Aug. Ponds	1983	2,189	24	36		
Sept. Hatchery	1983	2,983	87	95	1.41	.25< p <.5
Sept. Ponds	1983	3,292	114	105		
Sept. Hatchery	1985	20,950	286	1,118	78.12	p <.001
Sept. Ponds	1985	12,744	1,587	755		

the various enhancement efforts influenced survival. Additionally, the sizes of the hatchery and pond reared fish when released were different and this variable may have influenced survival.

Pond Study

Eleven grayling from the 1985 stocking were captured in Pit 1 (Table 6). No abundance estimate was calculated because no marked fish were recaptured. The estimated length increase from the time of stocking was 43 mm ($n = 11$, $SE = 2.35$ mm). In addition, 20 grayling from enhancement efforts prior to 1985 were captured.

In Pit 2, 172 grayling from the 1985 stocking were captured and 19 were subsequently recaptured (Table 6). The estimated abundance was 552 (95% confidence interval = 392 to 861). The estimated survival from time of stocking to age 1 was 0.33 (95% confidence interval = 0.24 to 0.52). The estimated length increase was 40 mm ($n = 17$; $SE = 1.5$ mm). No grayling were captured from enhancement efforts prior to 1985.

Other studies have found that the survival rate for sac-fry released in shallow ponds ranged from 0.065 to 0.26 over a three month period during the summer (Holmes et al. 1986 and Ridder 1985). The survival rate would be even lower at age 1. When compared to sac-fry releases, survival to age 1 was greater for grayling stocked as fingerlings in Pit 2. This apparent higher survival rate for stocked grayling fingerlings may be exhibited in other gravel pits and ponds. However, until more sampling is conducted, these results should not be extended to ponds in general.

Based on these results, fingerlings may be preferred for stocking. However, the costs of producing sac-fry and fingerlings should also be considered. A four gram fingerling costs nearly six times more to produce than a sac-fry (Parks, ADF&G, personal communication). To offset the additional hatchery costs, the survival rate for fingerlings must be about six times greater. A study to evaluate use of sac-fry versus fingerlings for enhancement based on minimizing enhancement costs is needed. Stocking size, survival, and costs will be evaluated in planned enhancement experiments to be conducted in 1987 and 1988 in several Alaskan lakes and ponds. Future lake and pond enhancement techniques will be revised based on these results.

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Table 6. Number of age 1 grayling captured, marked and recaptured in two Steese Highway ponds, 1986.

Pond	Date	Number Captured	Number Recaptured	Number Marked	Marked Fish at Large
Pit 1	06/25/86	9	0	9	0
	06/26/86	2	0	2	9
	06/27/86	0	0	0	11
Pit 2	06/24/86	98	0	98	0
	06/25/86	54	7	46	98
	06/26/86	13	4	9	144
	06/27/86	26	8	18	153

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